



Sustainable Energy Connectivity in Central Asia



Funded by
the European Union

Lectures to students of higher educational institutions of Turkmenistan

Institute of International Relations under the Ministry of Foreign Affairs of Turkmenistan

Ashgabat, Monday, 29 April 2024

Promoting energy efficiency in industry and buildings - European Union approaches

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Energy Efficiency



Energy Efficiency Directive

- A **binding energy efficiency target** of reducing final energy consumption by at least 11.7% compared to projections of the expected energy use for 2030
- Extending existing energy savings obligations (1.5%/y)
- **Empower consumers** by granting access to information on their energy consumption
- Introducing an annual energy consumption reduction target of 1.9% for the public sector as a whole and extending the annual 3% buildings renovation obligation to all the levels of public administration



Energy Performance of Buildings

- Clear vision for a **decarbonised building stock by 2050**;
- **Smart & Efficient buildings** through use of Information and Communication Technologies and Smart Technologies;
- **Smart Finance for Smart Buildings** initiative:
 - More effective use of public funding
 - Aggregation of funds
 - De-risking

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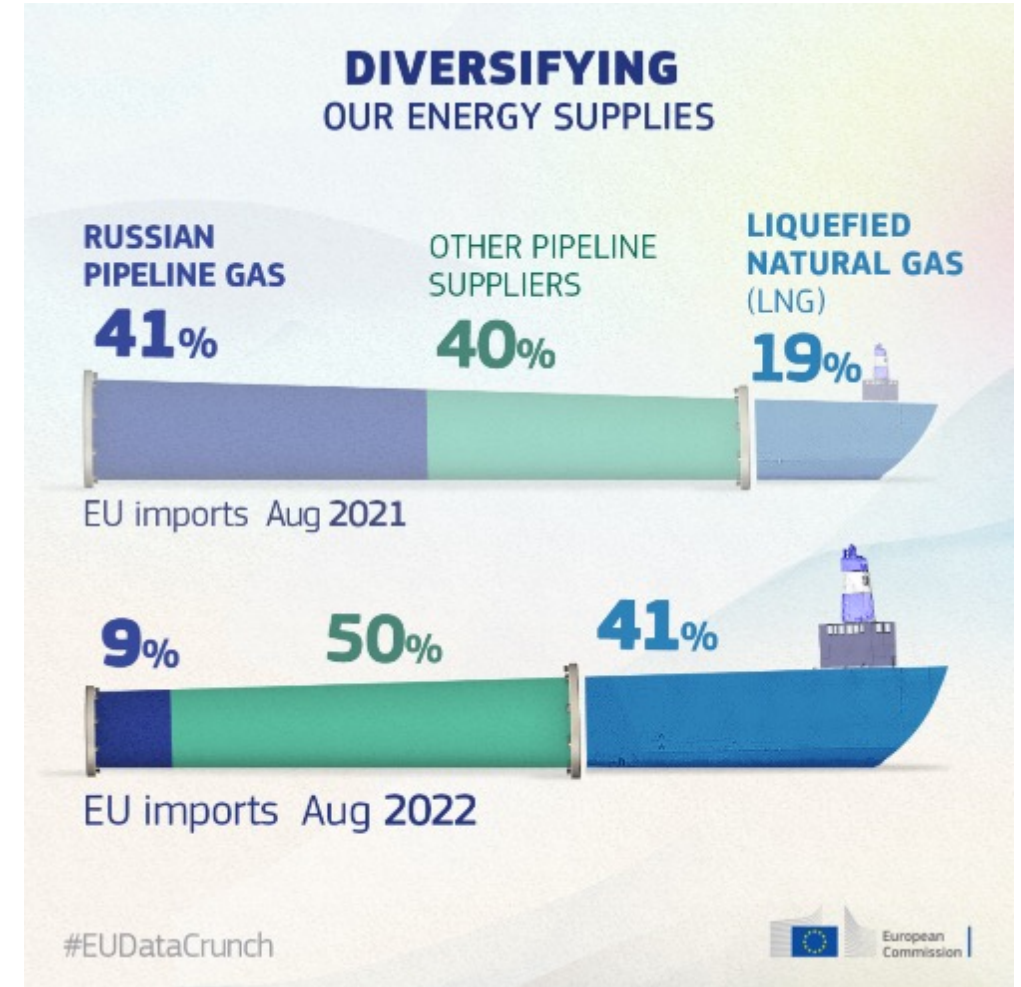


Industry

- **Expanded Audit Requirements** for SME companies if they are large energy consumers
- Large industrial energy consumers required to implement systems to **monitor and optimize energy efficiency**
- EUTaxonomy and EU directive on corporate sustainability
- List of new product groups;
- Bringing in a new obligation to monitor the **energy performance of data centres**
- Promoting **local heating & cooling plans in larger municipalities**

Driving forces - REPowerEU Plan

- Reduced its dependency on Russian fossil fuels
- Saved almost 20% of its energy consumption
- Introduced the gas price cap and the global oil price cap
- Doubled the additional deployment of renewables
- Since September 2022, Russian gas accounts for only 8% of all pipeline gas imported into the EU, compared to 41% of EU imports from Russia in August 2021



Building sector

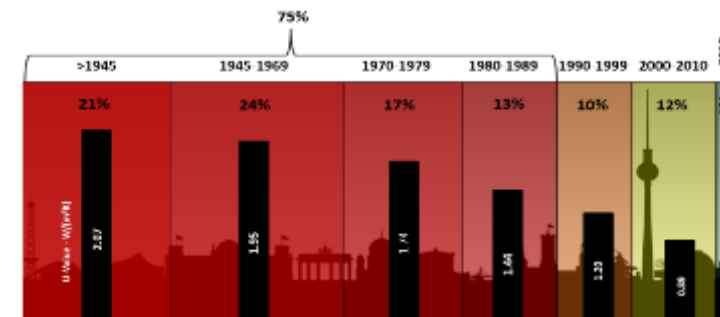
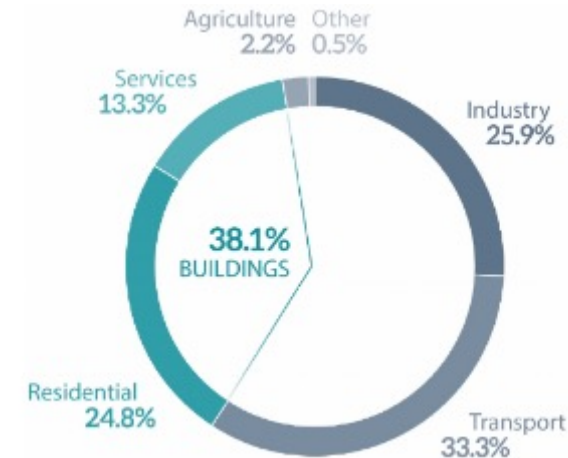
Buildings are the single largest energy consumer in Europe, they are responsible for approximately 40% of EU energy consumption and 36% of CO₂ emissions.

At present, about 35% of the EU's buildings are over 50 years old and almost **75% of the building stock is energy inefficient**. At the same time, only about 1% of the building stock is renovated each year.

Renovation of existing buildings can lead to significant energy savings as it could reduce the EU's total energy consumption by 5-6% and lower CO₂ emissions by about 5%. Investments in energy efficiency stimulates the economy, especially the construction industry, which generates about 9% of Europe's GDP and directly accounts for 18 million direct jobs. SMEs in particular would benefit from a boosted renovation market, as they provide more than 70% of the added-value of the EU's building sector.

Energy consumption by sector in EU

Source: Eurostat



Age of the EU building stock and corresponding average U-value for building envelopes.

Energy Performance of Buildings Directive - Main outcomes

The EPBD covers a broad range of policies and support measures to help national EU government boost the energy performance of buildings and improve the existing building stock

- **LONG-TERM RENOVATION STRATEGIES** EU countries must establish strong LTRS aiming at decarbonising the national building stocks by 2050, with intermediary milestones for 2030, 2040 and 2050. The strategies should contribute to achieving the energy efficiency targets as set in the national energy and climate plans (NECPs)
- **COST-OPTIMAL MINIMUM ENERGY PERFORMANCE REQUIREMENTS** for new buildings, existing buildings undergoing major renovation and the replacement or retrofit of building elements like HVAC, roofs and walls
- **NZEB** all new buildings must be nZEB from 31 Dec. 2020. While all new public buildings needed to be nZEB since 31 Dec. 2018
- An **EPC** must be issued when a building is sold or rented, and inspection schemes for HVAC systems must be established
- **ELECTRO-MOBILITY** is supported by introducing minimum requirements for car parks over a certain size and other minimum infrastructure for smaller buildings
- **SMART READINESS**, an optional European scheme for rating the 'smart readiness' of buildings is introduced
- **SMART TECHNOLOGIES** are by imposing requirements on the installation of building automation and control systems, and on the devices that regulate temperature at room level
- **HEALTH AND WELL-BEING OF BUILDING DWELLERS** is addressed, for instance by taking into consideration the quality of air and ventilation
- **FINANCIAL MEASURES** EU countries must draw up lists of national financial measures to improve the energy efficiency of buildings

Energy performance of buildings Directive



Long-term renovation strategies

- Vision of a **decarbonised building stock by 2050**
- **one-stop-shops** for the energy renovations of buildings and Smart Finance
- **definition of deep renovation and the introduction** of building renovation passports



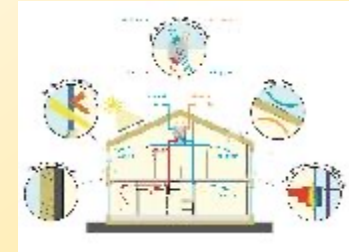
Smartness readiness indicators

- aims at:
- the ability of a building to manage itself,
 - to interact with its occupants,
 - to take part in demand response and
 - to contribute to smooth, safe and optimal operation of connected energy assets



Electro mobility

- **Recharging points in commercial buildings**
- Precabeling in residential buildings
- a **gradual phase-out of stand-alone** boilers powered by fossil fuels, starting with the end of subsidies to such boilers from 1 January 2025



zero-emission buildings

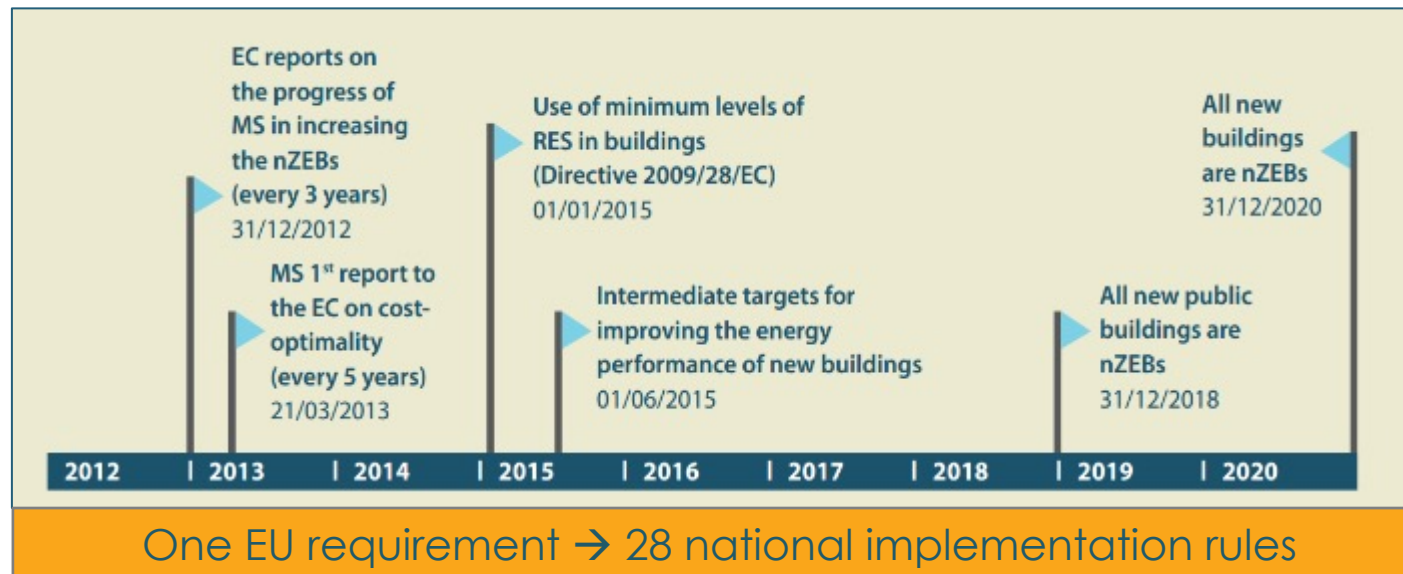
- an enhanced standard for new buildings, including a more ambitious vision for buildings to be **zero-emission**
- ensuring new buildings are **solar-ready**
- **health and wellbeing** of building users, through its air quality and ventilation considerations

Energy performance of buildings Directive

All EU Countries must adopt a **long-term renovation strategy to support the renovation of their national building stocks** so that they develop into highly energy efficient and decarbonised building stocks by 2050.

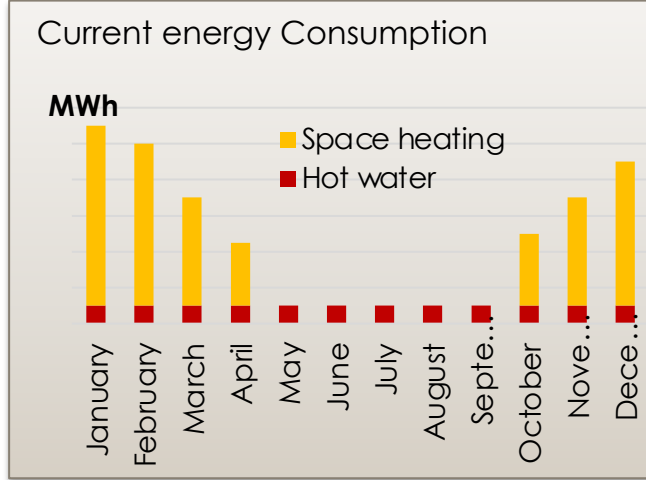
Such a requirement was set out in the EPBD – Energy Performance of Buildings Directive.

The national strategies will form part of each member country's integrated **National Energy and Climate Plans (NECPs)**

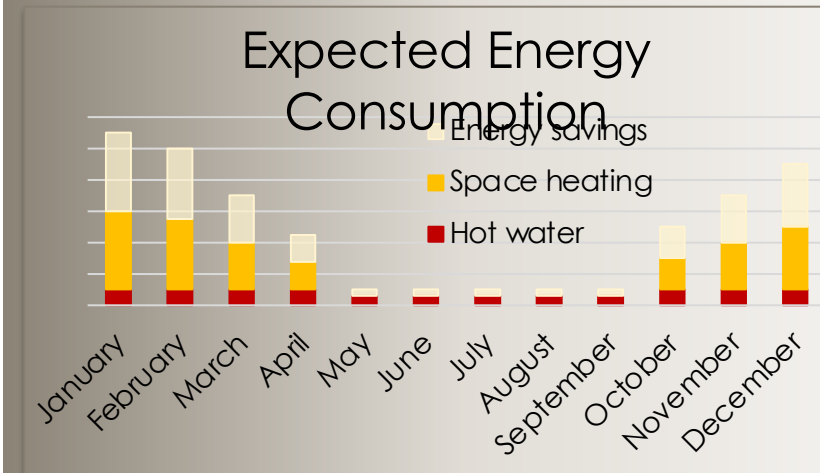


Energy Performance certificates in buildings

Energy Audit

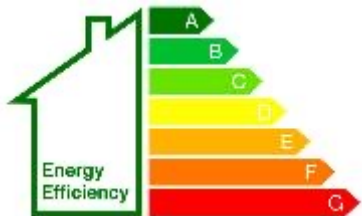


Identify and quantify measures



EPC - Energy Audit Report

Economic and financial analysis



Energy performance certification of buildings


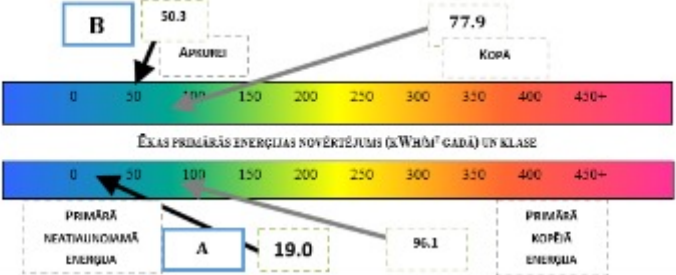
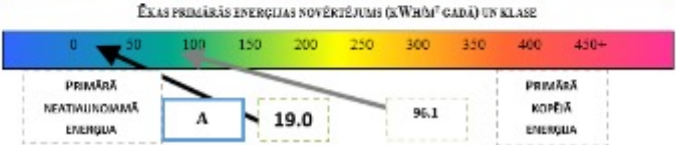
- All public buildings above 250 m²
- All apartment buildings have to be certified by 2040
- All single family buildings have to be certified by 2050
- If apartment building uses more than 150 kWh/m² per year for space heating it has to plan energy efficiency measures

Increased reliability, quality and digitalisation of Energy Performance Certificates with energy performance classes to be based on common criteria:

- Quality
- harmonisation (based on a harmonised scale using only letters from A to G and a template)
- accessibility of Energy Performance Certificates

Inspection of heating and air-conditioning systems

Foreseen calculation life-cycle Global Warming Potential (GWP) and its disclosure through the energy performance certificate of the building.

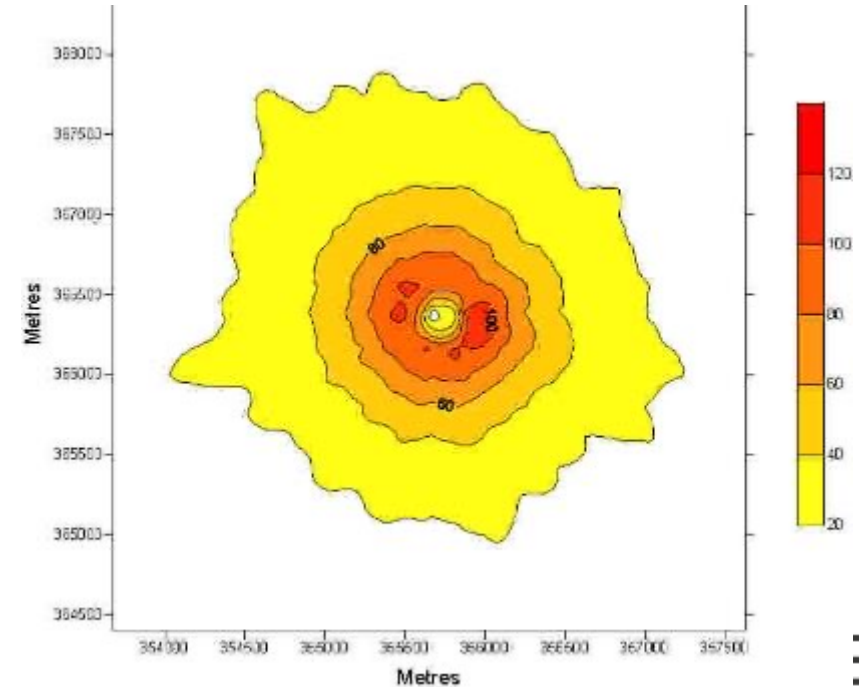
| ĒKAS ENERĢOEFECTIVITĀTES CERTIFIKĀTS | |  | |
|---|--|---|---|
| ĒKAS PAGAIDU ENERĢOEFECTIVITĀTES CERTIFIKĀTS | | | |
| REĢISTRĀCIJAS NUMURS | | BIS-ĒĒD-2-2021-2421 ^[1] | |
| DZĪRĪGS | | 17.08.2024. ^[2] | |
| ĒKAS ENERĢOEFECTIVITĀTES VEIDS | Paaugstinātas enerģētiskās efektivitātes ēka pēc izstrādes ^[3] | | |
| OBJEKTA VEIDS | Ēka pagaidu enerģētiskās efektivitātes sertifikāts (EPB_OBJECT_CAT_RES) ^[4] | | |
| ĒKAS VEIDS | Dzīvokļmāju ēka ^[5] | | |
| ADRESE | "Lielbaltas", Jaunbaltiņi, Jaunbaltiņu pagasts, Saldus novads, LV-3876 ^[6] | | |
| ĒKAS DAĻA | Virs ēka ^[7] | | |
| KĀDĒSTRA APZĪMĒJUMS | 84560030347001 ^[8] | | |
| ĒKAS RAĢSTUROJUMS | | | |
| Būvniecības gads ^[9] | 2021. ^[10] | | Pabeigšanas gads ^[11] |
| Silvju skaits | 3 | Vērtēšanas, f. pazemes, f. mansarda, f. jumta stāvs | |
| Kopējā platība | 1120,9 m ² | Referenču platība ^[12] | 844,3 m ² |
| Referenču tilpums ^[13] | 2111 m ³ | Vidējais telpstāvju augstums | 2,3 m |
| ĒKAS ENERĢOEFECTIVITĀTES PĒLĪTĒJUMA VEIDS (D) | Paaugstinātas enerģētiskās efektivitātes ēka ^[14] | | |
| ENERĢOEFECTIVITĀTES NOVĒRTĒJUMA VEIDS | Aprēķināts, pie noteiktas ekspluatācijas (pēc būvniecības) ^[15] | | |
| ĒKAS ENERĢOEFECTIVITĀTES NOVĒRTĒJUMS | Pie noteiktas ekspluatācijas ^[16] | | |
| ĒKAS ENERĢOEFECTIVITĀTES NOVĒRTĒJUMS (kWh/m² gadā) UN KLASE ^[17] | | | |
|  | | | |
| ĒKAS PRIMĀRĀS ENERĢIJAS NOVĒRTĒJUMS (kWh/m² gadā) UN KLASE | | | |
|  | | | |
| ĒKAS ENERĢOEFECTIVITĀTES RĀDĪTĀJS ^[18] | | VĒRTĒJUMS PĀR ĒKAS ATBILSTĪBU NORMATĪVO AKTU PRASĪBĀM | |
| APRĪSĒ | 50,3 | A ^[19] | ĒKAS ATBILSTĪBA GANDRĪS NULLES ENERĢIJAS ĒKAS PRASĪBĀM |
| KĀRSTĀ ĒDENS SAGATAVOŠANAI | 25,6 | A | ĒKAS RĀDĪTĀJU PĀRBAUDE, PAMATOJOTIES UZ FAKTISKO DĪVNĪCĪBAS REZULTĀTU ^[20] |
| MĒRANISKAJAI VENTILĀCIJAI | 0,0 | A | |
| APGAISMĪJUMAM ^[21] | n/a | A | |
| DZESĒŠANAI | 0,0 | A | |
| PĀRILDĒ | 2,0 | A | |
| KOPĀ | 77,9 | A | Oglekļa dioksīda emisijas novērtējums, t CO ₂ /gadā |
| | | | Oglekļa dioksīda emisijas novērtējums, kg CO ₂ /m ² gadā |
| ĒKAS ENERĢOEFECTIVITĀTES IZDARĪTĀJS | NEATKARĪGAIS EKSPERTS ^[22] | | PARAKSTS |
| | EKSPERTA SERTIFIKĀTA NUMURS ^[23] | | |
| | DATUMS ^[24] | | |

HVAC system energy audit

- Under the Energy Performance of Buildings Directive (2010/31/EU), all EU countries have established **independent control systems for energy performance certificates and inspection reports for heating and cooling systems**



Flue gas analysis (CO, NO_x, t, O₂), fuel analysis (moisture %, Q_{zd}), heat carrier flows (m³/s)



Requirements for energy auditors in buildings

Higher professional or academic education, if the relevant educational program provides knowledge of thermal engineering of building envelope, building engineering systems (heating, cooling, ventilation, air conditioning, water supply, lighting), building climatology and indoor microclimate, energy efficiency assessment and calculation methods;

Has gained **at least two years of practical experience** in assessing the energy efficiency of buildings, **working under the supervision of an independent expert**, whose competence has been proven for assessing the energy efficiency of an operational building or its part and issuing a building energy certificate, as well as for assessing the energy efficiency of planned new constructions, reconstructed or renovated buildings or their parts and issuing a temporary building energy certificate;

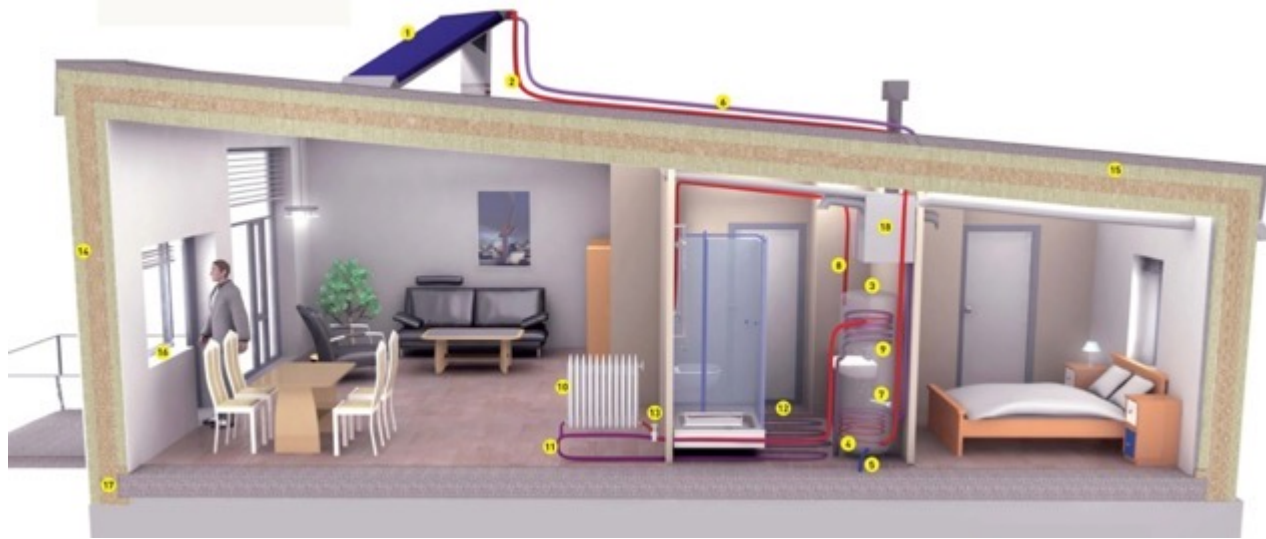
Passed the exam at the certification institution (LSGUTIS).



Nearly Zero Energy buildings

Transforms a building or building:

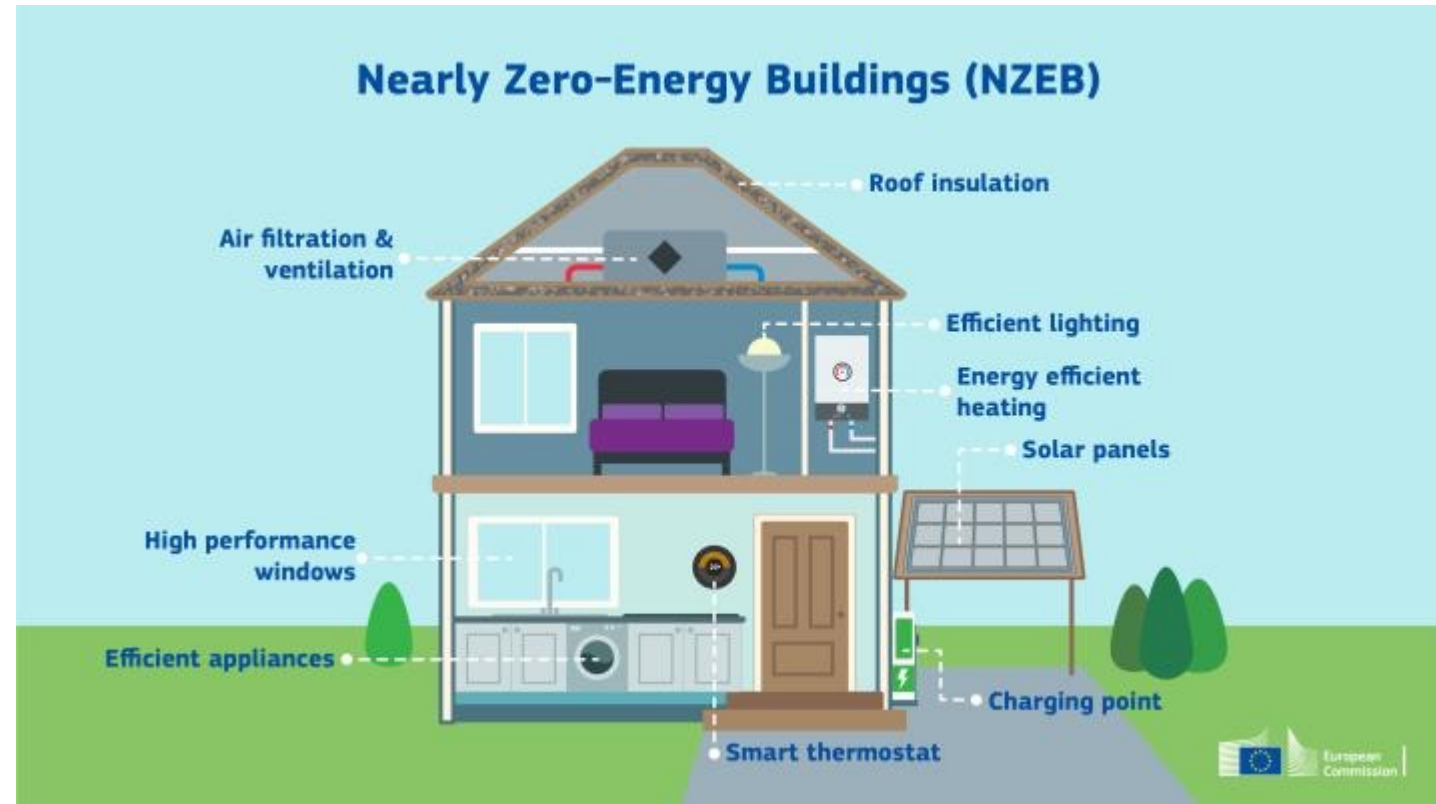
- before 1 January 2030, into a **nearly zero-energy building** (starting from 2021)
- as of 1 January 2030, into a **zero-emission buildings** (as of 1 January **2028**, new buildings owned by public **bodies**)



Bosco Verticale, Milan

Zero-emission buildings

- Nearly zero-emission building (NZEB) means a building that has a very **high energy performance**, while the nearly zero or very low amount of energy required should be covered to a very **significant extent by energy from renewable source**
- and **without on-site carbon emissions** from fossil fuels.
- Focus of the proposal is the reduction of **operational greenhouse** gas emissions, ZEB definition further include the calculation life-cycle Global Warming Potential (GWP) and its disclosure through the energy performance certificate of the building.



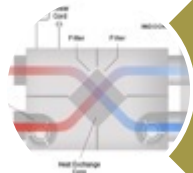
Example on nZEB definicetion in Latvia



Building energy consumption for heating ≤ 40 and 45 kWh/m² per year.



Building's primary non-renewable energy consumption for heating, hot water supply, mechanical ventilation, cooling, and lighting (applicable to non-residential buildings) is less than or equal to 95 kWh/m² per year.



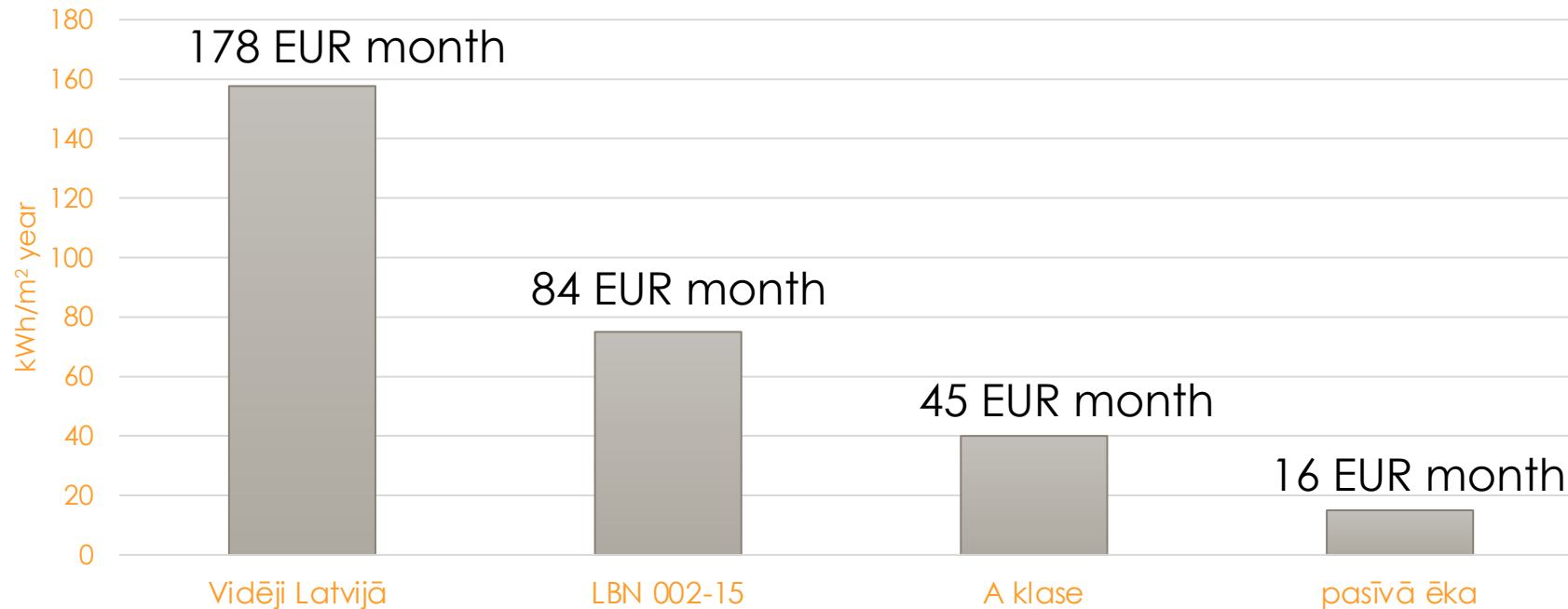
The building has installed engineering systems and energy-consuming devices that comply with at least Class A



A certain microclimate is provided in the rooms (Requirements for room temperature, air exchange, overheating in summer, ...)



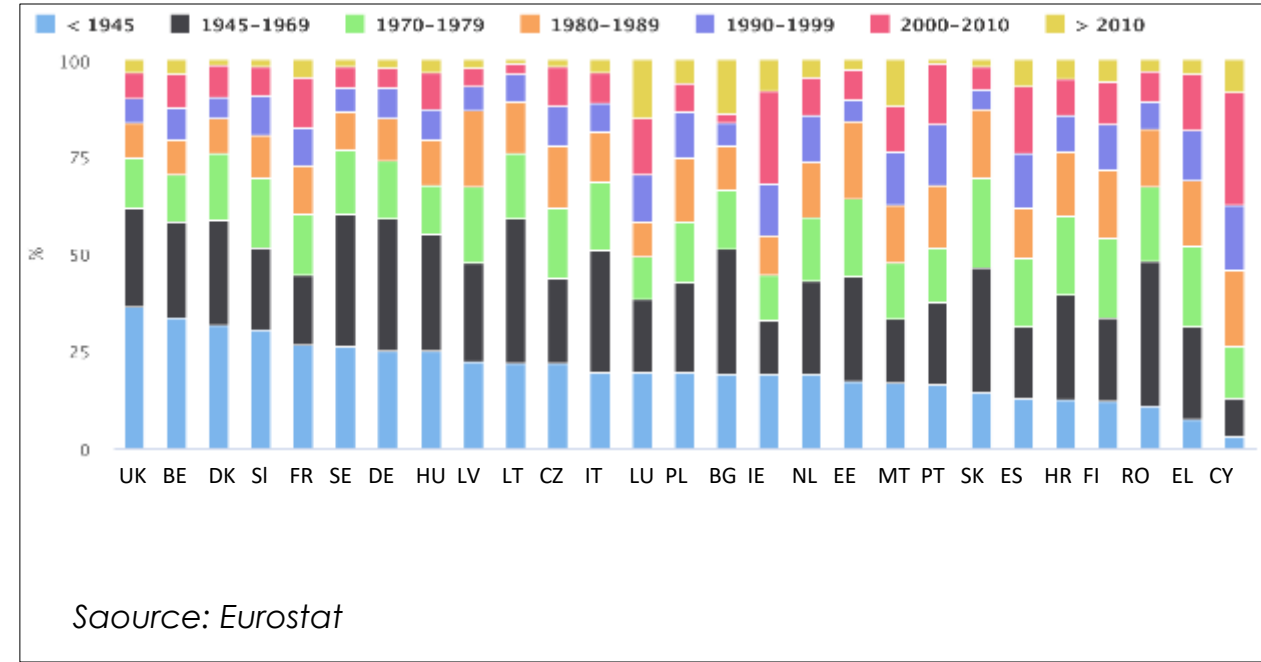
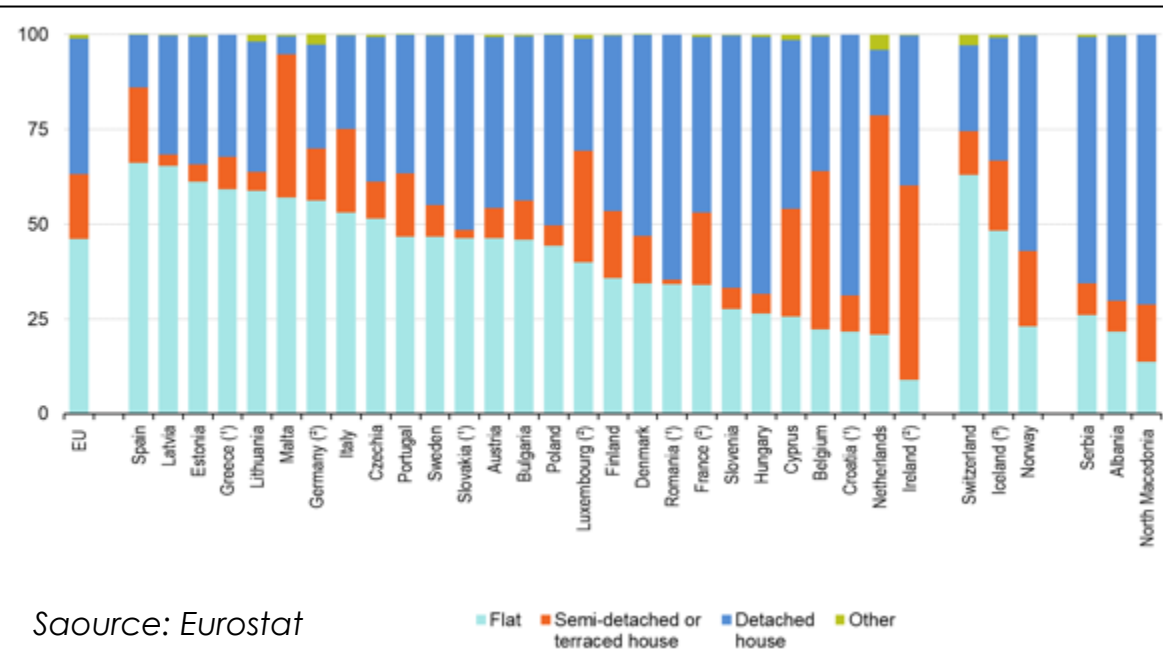
What it means for existing buildings - energy consumption and average heating costs for a 75 m² apartment



European Commission's recommendations of energy performance (EP) for NZEBs in different climate zones

| NZEB level of energy performance | Mediterranean Zone 1: Catania (others: Athens, Larnaca, Luga, Seville, Palermo) | Oceanic Zone 4: Paris (Amsterdam, Berlin, Brussels, Copenhagen, London, Prague) | Continental Zone 3: Budapest (Bratislava, Ljubljana, Milan, Vienna) | Nordic Zone 5: Stockholm (Helsinki, Tallinn, Riga, Gdansk, Tovarene) |
|--|--|--|--|---|
| Offices, kWh/(m² a) | | | | |
| net primary energy | 20–30 | 40–55 | 40–55 | 55–70 |
| primary energy | 80–90 | 85–100 | 85–100 | 85–100 |
| on-site RES primary energy | 60 | 45 | 45 | 30 |
| New single-family houses, kWh/(m² a) | | | | |
| net primary energy | 0–15 | 15–30 | 20–40 | 40–65 |
| primary energy | 50–65 | 50–65 | 50–70 | 65–90 |
| on-site RES primary energy | 50 | 35 | 30 | 25 |

Residential sector building stock



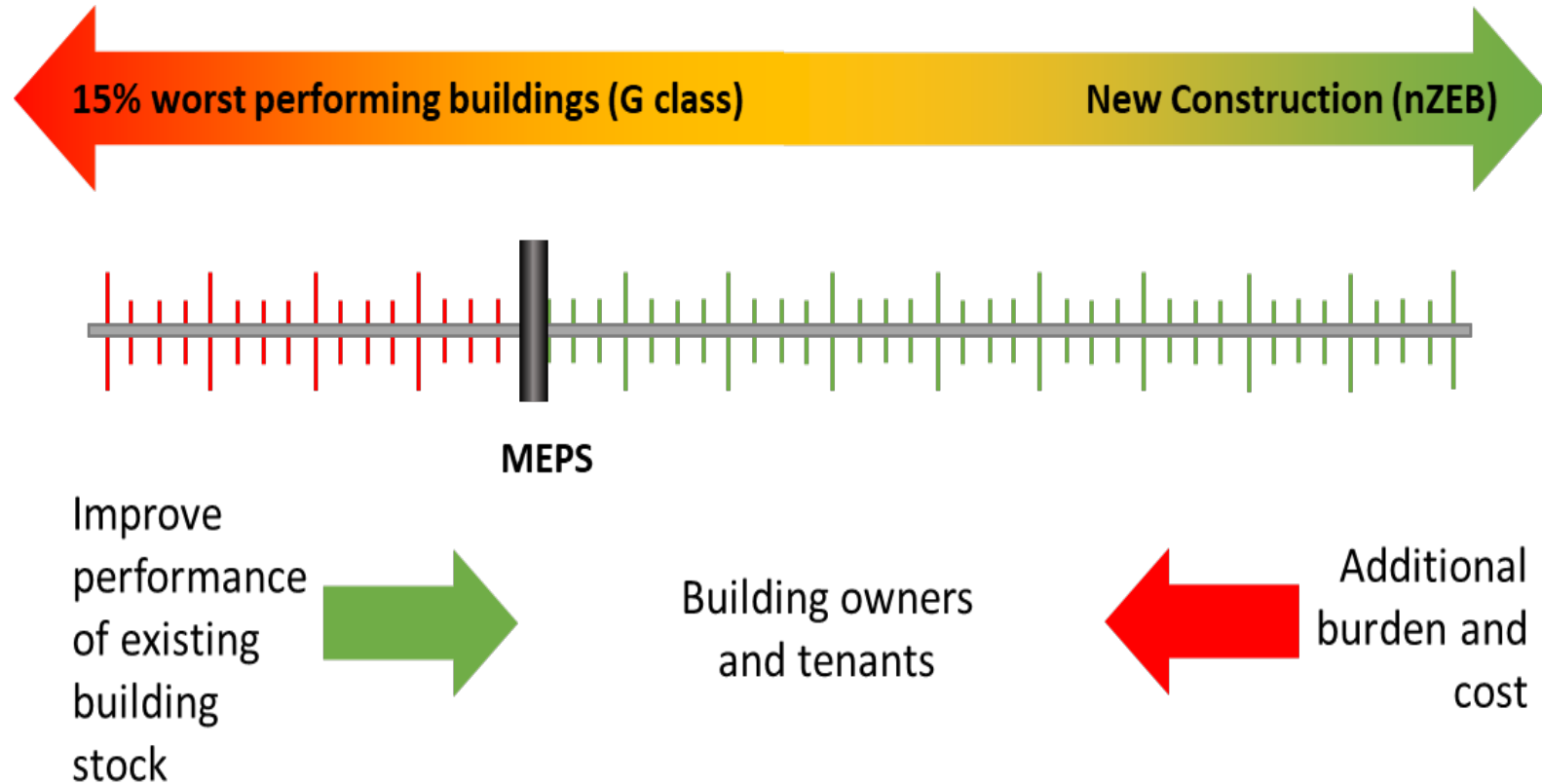
Distribution of the population by type of dwelling in %

- 46.2 % of the EU population lived in flats, more than one third (35.8 %) lived in detached houses and close to one fifth (17.0 %) lived in semi-detached;
- In n 2020, 19.9 % of residents of cities in the EU lived in an overcrowded household and almost half of the buildings were built before 1970;
- across the EU as a whole, 4.3 % of the population suffered from severe housing deprivation.

Breakdown of residential building by construction year

High energy costs

The main questions studied



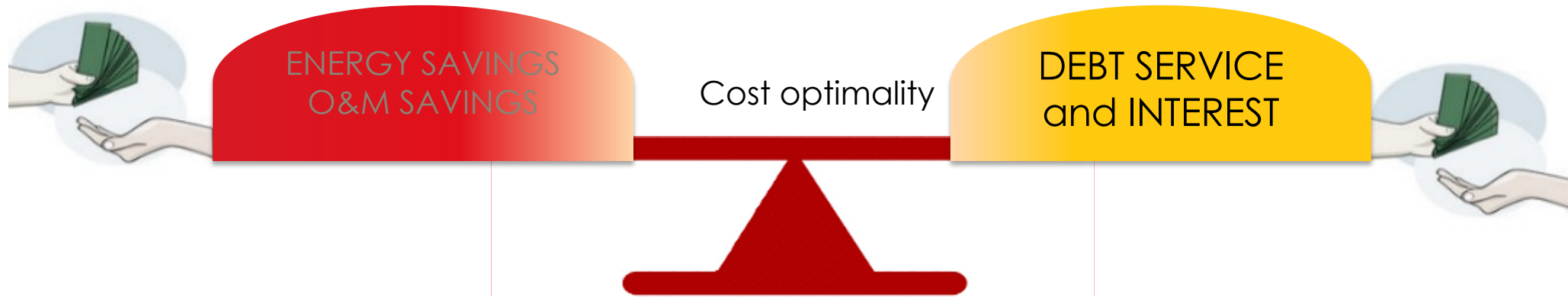
EPBD recast: Targeted worst performing buildings - buildings with the lowest energy performance class G as the worst-performing 15% of each MSs national building stock

Mapping existing MEPS

| Location | Metric used | Building type | Responsible authorities | Minimal Energy Performance Standard |
|-----------------------|---|--|----------------------------|--|
| England and Wales, UK | EPC | Owner occupied Social rented Private rented | Local authorities | EPC C by 2035 EPC C by 2035 EPC C by 2025 |
| Scotland, UK | EPC | Owner occupied Multi tenure/mixed use Private rented | Local authorities | EPC C by 2033 EPC C by 2045 EPC C by 2028 |
| Netherlands | EPC | Office buildings | Local authorities | EPC C by 2023 |
| France | EPC | Private buildings | NGOs and local authorities | EPC E by 2033 |
| France | Energy performance | Rented buildings | NGOs and local authorities | Above 450 kWh/m ² /year by 2023 |
| France | Final energy consumption | Tertiary buildings over 1000 m ² | NGOs and local authorities | 40% improvement in 2030 50% improvement in 2040 60% improvement in 2050 When compared to 2010 |
| Brussels, BE | EPC | Domestic and non-domestic buildings | Public authorities | EPC C+ (100 kWh/m ² /year) by 2050 |
| Flanders, BE | Technical measures | Private rented | Local authorities | Minimum roof insulation and glazing by 2023 |
| Boulder, USA | Points based on energy and carbon emissions | Private rented | Private inspectors | Maximum of 48 points in 2019 |

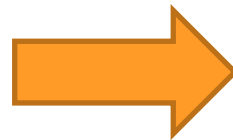


Cost optimality



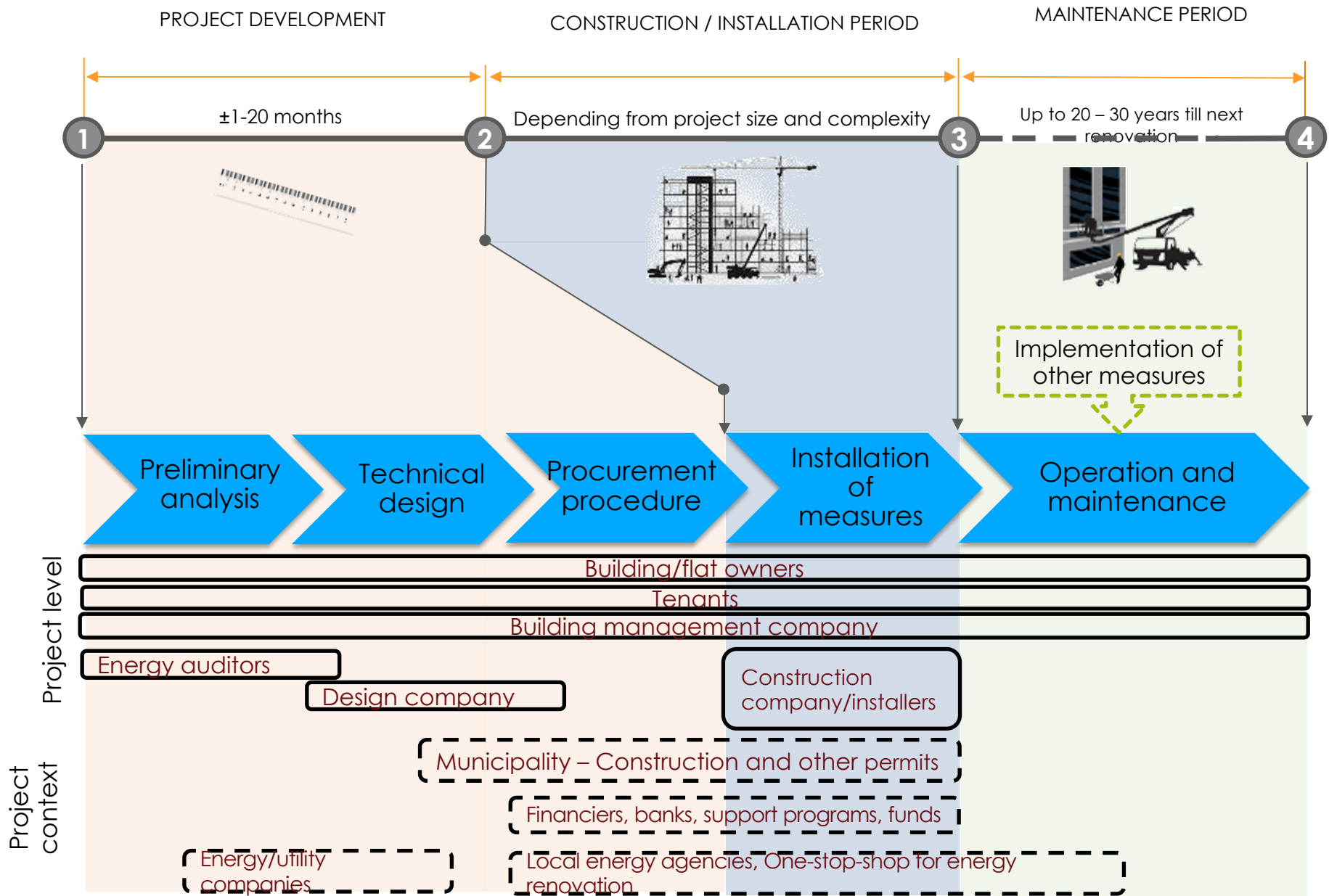
Analyses of available support (IT, SE, DE, LV):

- Financial instruments
- One-stop-agency



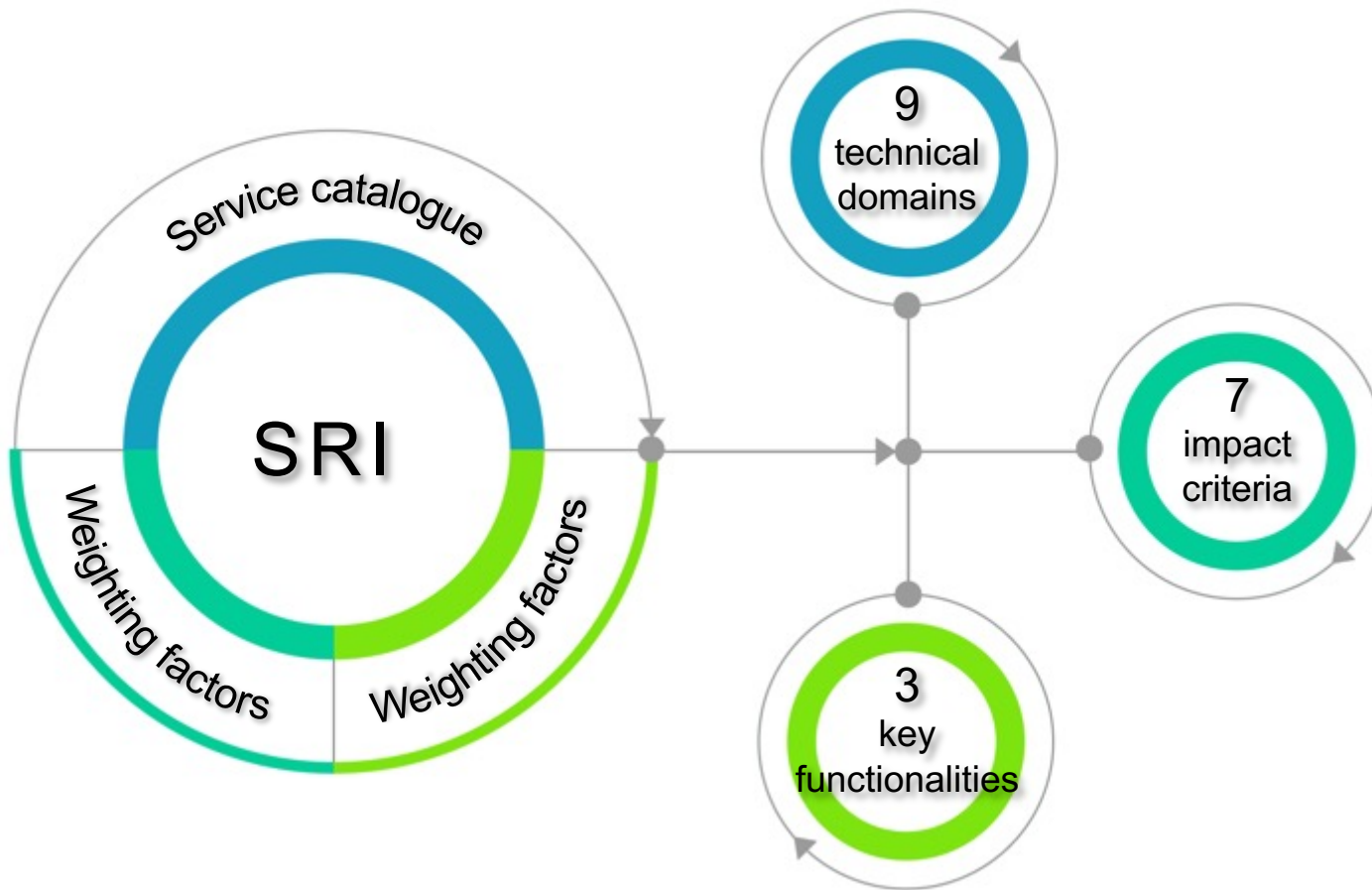
Municipalities and local governments

One-stop-shop



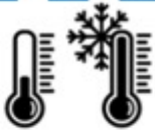






Source: modified from TRANSPARENCE

SRI smart readiness indicators



Weighting Methods (1/2)

| | | | | | | | |
|---------------------|---|---|--|---|---|---|---|
| Key functionalities | 1/3 | | 1/3 | | | | 1/3 |
| | Energy performance & operation | | Responds to the needs of occupants | | | | Energy flexibility |
| Impact criteria | 1/2 | 1/2 | 1/4 | 1/4 | 1/4 | 1/4 | 1/1 |
| |  |  |  |  |  |  |  |
| | Energy efficiency | Maintenance & fault protection | Comfort | Convenience | Health, well-being & accessibility | Info to occupants | Energy flexibility & storage |

Example of SRI assessment

THE BUILDING:

Building type Non-residential (office building)

Location Bettembourg, Luxembourg

Surface area 2200 m²

Construction year 2014

Specificities The NeoBuild building is a pilot project for environmental performance and renewable energy production. It allows testing novel technologies, materials and building components



MAIN TECHNICAL CHARACTERISTICS:

EPC*
class A

Heat pumps
(ground to water &
air to air)

Solar panels (thermal
& PV) on the roof and
on several sides

Energy
storage on
site

No active
cooling

Example of SRI assessment








HOW THE SRI WAS ASSESSED:

Assessment carried out by LIST. Use of the detailed service catalogue available in the SRI assessment package (available on request at <https://ec.europa.eu/eusurvey/runner/SRI-assessment-package>).










OUTCOMES OF THE SRI ASSESSMENT:

Overall SRI score: **67%**

Scores per impact criteria:

| | | |
|--------------------------------------|---|-----|
| Energy efficiency |  | 81% |
| Maintenance and fault prediction |  | 52% |
| Comfort |  | 75% |
| Convenience |  | 61% |
| Health, well-being and accessibility |  | 62% |
| Information to occupants |  | 59% |
| Energy flexibility and storage |  | 68% |

Scores per technical domains:

| | | |
|---------------------------|---|-----|
| Heating |  | 74% |
| Cooling |  | - |
| Domestic hot water |  | 57% |
| Ventilation |  | 60% |
| Lighting |  | 85% |
| Dynamic building envelope |  | 45% |
| Electricity |  | 43% |
| Electric vehicle charging |  | 0% |
| Monitoring and control |  | 60% |

Building deep renovation

- The building was constructed in 1972.
 - Heated area: 3346 m²
 - Energy consumption: 159 kWh/m² per year
 - Typical building
-
- Heating season: 207 days
 - Average temperature during the heating season: -1.2°C
 - Design temperature: -23.8°C

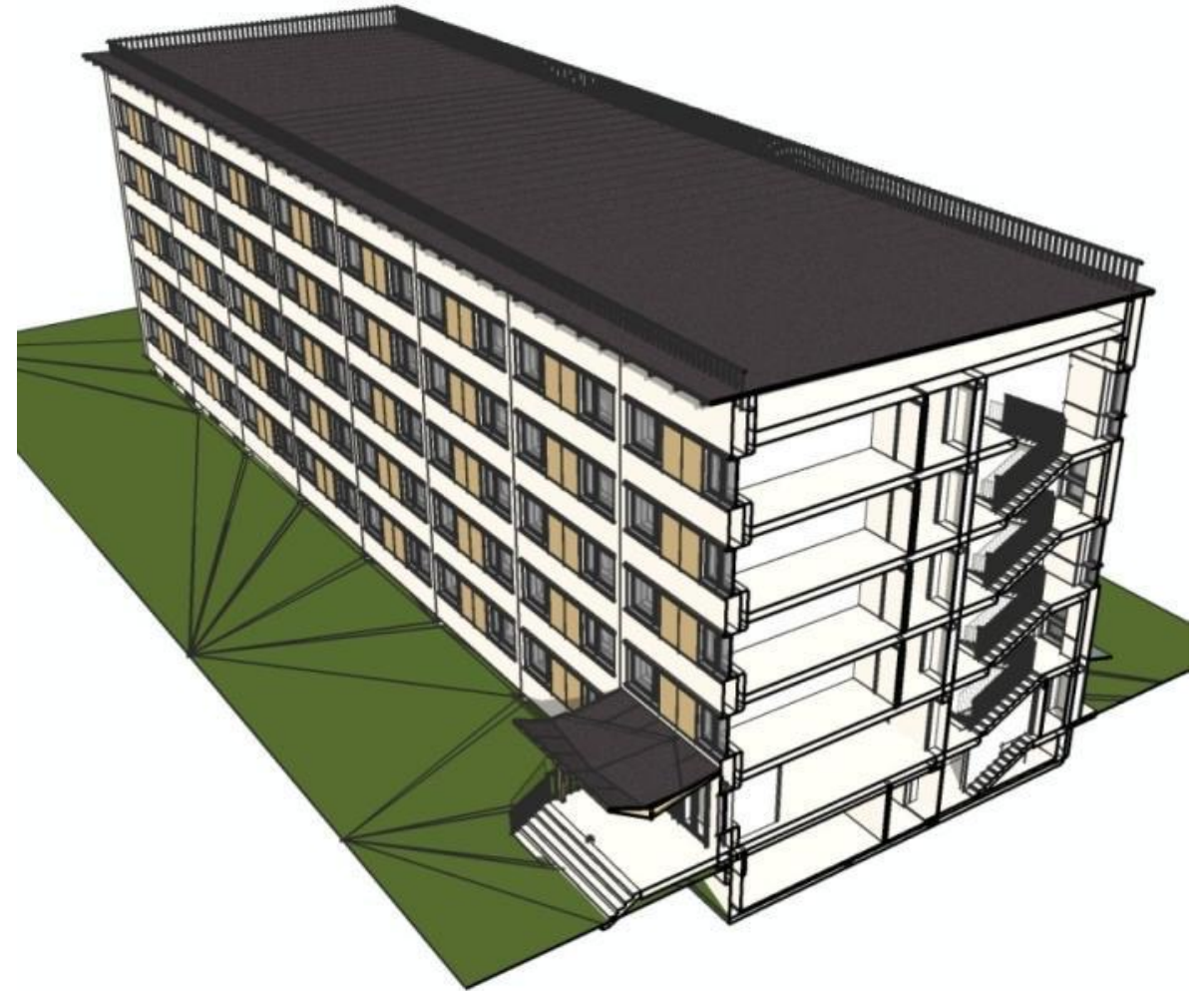


Before renovation

Building deep renovation

- Ventilation system with heat recovery
- Main ducts within the roof insulation layer, >70 cm
- Piping within the wall insulation structure, >40 cm

| | Before, W/m ² K | After, W/m ² K |
|---------|-------------------------------|------------------------------|
| Walls | U=1.05 | U=0.09 |
| Roof | U=0.52 | U=0.06 |
| Windows | U=2,6 | U=0.80 |

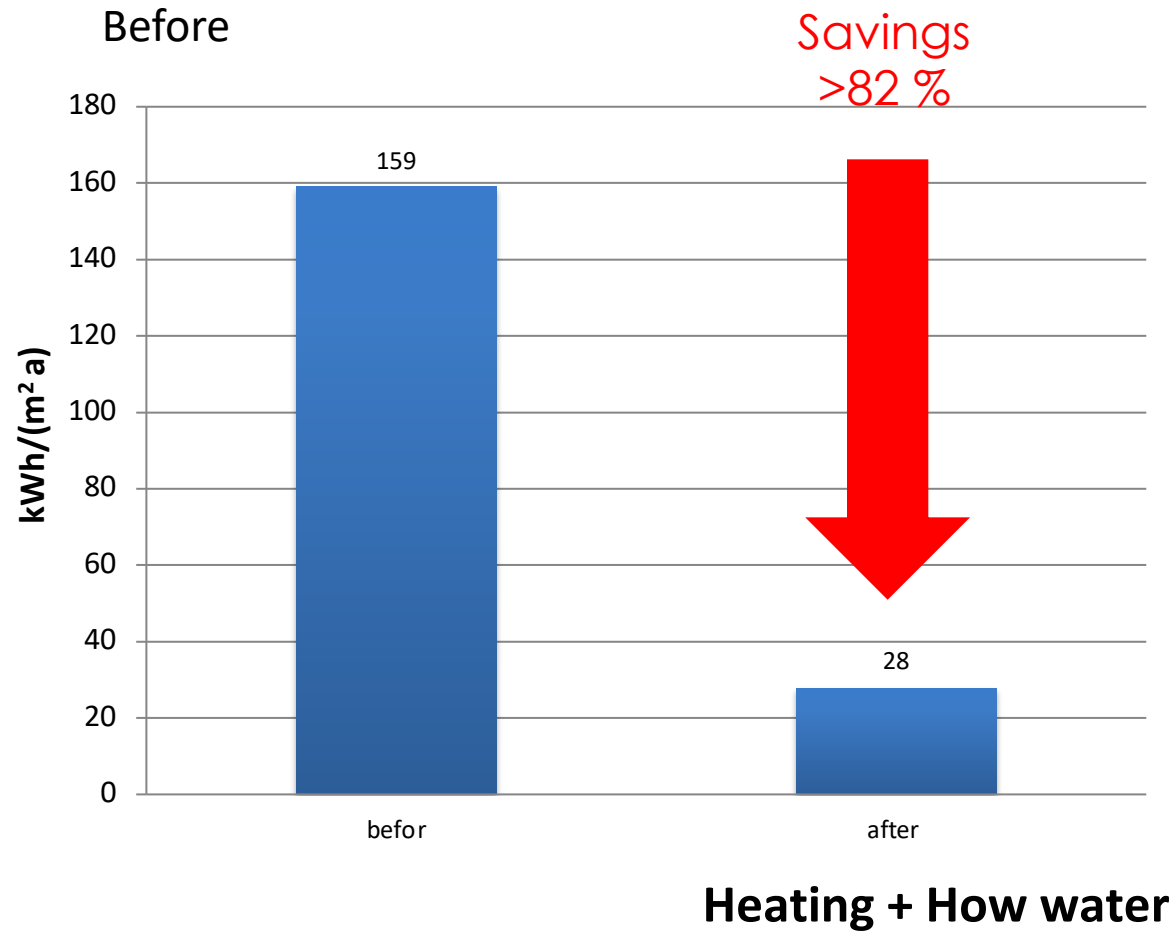




Building deep renovation



Before and after



EU Industrial Energy Efficiency: Insights and Focus

1. Potential for Energy Savings:

- IEA 2020 report highlights that 59% of total industrial energy savings in the EU could be achieved in less energy-intensive sectors.
- Emphasizes the critical role of SMEs, which make up 99% of European firms.

2. Energy Efficiency Progress and Challenges:

- The industry sector has seen significant improvements in energy efficiency over the last decade.
- Despite high cost-effective savings potential, challenges remain in promoting energy audits and implementing recommended measures, especially among SMEs.

3. Importance of Energy Audits:

- Energy audits are a key policy tool for boosting industrial energy efficiency and increasing the use of Renewable Energy Sources (RES).
- Limitations include the promotion of energy audits within SMEs and the need for follow-up audits to ensure implementation of recommended measures.

4. Awareness and Investment Differences:

- As per the EIB "Going Green 2020" report, awareness of energy efficiency benefits is crucial for the adoption of energy efficiency measures.
- Variations exist among project partner countries in investments related to energy efficiency and the availability of energy audits (EIB, 2020).



Audit obligations, technical competence requirements and investments reporting

1.Expanded Audit Requirements:

- All companies exceeding a specific energy consumption threshold must conduct energy audits.
- Includes small and medium-sized enterprises (SMEs) with significant energy-saving potential.

2.Mandatory Energy Management Systems:

- Large industrial energy consumers required to **implement systems to monitor** and optimize energy efficiency.

3.Professional Competency Standards:

- EU countries must ensure **energy-related professionals meet enhanced competency requirements.**
- Applies to energy service providers, auditors, managers, and installers.

4.Governance and Transparency:

- **Directive requires reporting on energy efficiency investments**, including energy performance contracts.
- Ensures accountability through Governance Regulation – **ESG reporting (sustainability reporting)** .

5.Support Mechanisms:

- Establishes assistance for project development at national, regional, and local levels.



Energy audits (according to Energy Efficiency Law)

- **Mandatory energy audits** (or certified an energy management system or introduced and certified an environmental management system, and in this system a continuous energy consumption evaluation process is ensured in order to control and reduce energy consumption, covering at least 90 per cent of the total final energy consumption, and energy consumption evaluation process has been ensured)
- **Large enterprises** (large enterprise is an economic operator which employs more than 249 employees or whose turnover of the reporting year exceeds 50 million euros, and the annual balance in total - 43 million euros)
- **Large electricity consumers** (large electricity consumer is an economic operator the annual electricity consumption of which exceeds 500 MWh/year in two consecutive calendar years)

Energy audit has to be **repeated every 4 years**

There are **276 large enterprises** in Latvia

There are **1086 large electricity consumers** in Latvia

The large enterprise and large electricity consumer shall introduce all or at least **three energy efficiency improvement measures** with the greatest estimated energy savings or economic return indicated in the first or current energy audit report (or within the framework of an energy management system or supplemented environmental management system)



Energy auditing in industry

Latvian National Accreditation Bureau (LATAK)

accredited conformity assessment body by LATAK

LSGUTIS – Association of HVAC engineers

independent expert's/energy auditors competence certification

Energy audits in buildings:
1.1 EPC for new buildings
1.2 EPC for existing buildings

1.3. Inspection of heating and air conditioning systems (HVAC)

Accreditation of institutions

Energy audit companies (inspection institutions) for large enterprises

Energy audits for large companies

Energy audits and energy balance for big energy consumers



Private professionals



Energy audit companies



Requirements for the Energy Auditor companies

- The energy auditor is a **legal person – company**:
- members of its **staff are not** designers, manufacturer, suppliers of technology or installer **of the enterprise to be audited**
- employees have **higher education** in any sector of engineering sciences (**energy, thermal energy, thermal engineering, environmental engineering**)
- have a good knowledge of the energy audit procedures of enterprises, ...
- Ensure the **insurance of their civil and professional liability** in relation to energy audit activities of the enterprise
- preserve **confidentiality**
- energy auditor shall be a conformity assessment and inspection authority which is **accredited by the national accreditation authority** (there is a **accreditation** visit each year) - **LVS EN ISO/IEC 17020:2012**
- ISO/IEC 17020:2012 specifies requirements for the competence of bodies performing inspection and for the impartiality and consistency of their inspection activities.



Eiropas Akreditācijas kooperācijas Daudzpusējā līguma (EA MLA) dalībnieks testēšanas un kalibrēšanas laboratoriju, produktu, personu un pārvaldības sistēmu sertificēšanas institūciju, inspicēšanas, validācijas un verificēšanas institūciju akreditācijas jomās

AKREDITĀCIJAS APLIECĪBA

Valsts aģentūra "Latvijas Nacionālais akreditācijas birojs"
ar šo apliecina, ka

Sabiedrība ar ierobežotu atbildību "EKODOMA"

Reģistrācijas numurs: 40003041636

Juridiskā adrese: Noliktavas iela 3-3, Rīga, LV-1010

atbilst standarta LVS EN ISO/IEC 17020:2012 prasībām un ir
kompetenta veikt inspicēšanu

atbilstība periods no 2020. gada 25. jūlija līdz 2025. gada 24. jūlijam

Sustainable Energy Connectivity In Central Asia



Measuring instruments – depending on the audit objectives. They are also verified according to LATAK (Latvian National accreditation Bureau) requirements

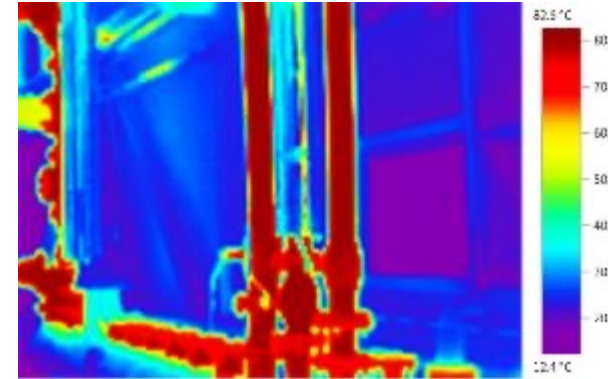
EN ISO 50001 (Energy Management Systems), or EN 16247-1 (Energy Audits)



Lighting



Heating and steam systems



Compressed air systems



Adjustment of boilers



Energy monitoring and process management

